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METHOD AND DEVICE FOR MANAGING AN INSTALLATION FOR INTERMEDIATE STORAGE OF FLAT ARTICLES

The invention is situated in the field of storage engineering and concerns a method and a device according to the generic terms of the corresponding, independent claims. Method and device serve for managing an installation for intermediate storage of flat articles, in particular of printed products, wherein for intermediate storage large numbers of the articles are combined in storage formations (e.g., wound into rolls), wherein storage formations (e.g., rolls) are intermediately stored and wherein following intermediate storage the articles are once again released from the storage formations (e.g., unravelled from the rolls). Corresponding installations comprise stations for establishing storage formations (e.g., winding stations for rolling up), stations for dissolving storage formations (e.g., unwinding stations for unravelling), a plurality of supporting elements for carrying or holding together storage formations (e.g., roll stands with roll cores or roll cores only) and a storage area with storage spaces for supporting elements with storage formations, or for supporting elements without storage formation (loaded and empty supporting elements).

Part of the management of such an installation are in particular the following steps: Positioning empty or loaded supporting elements (e.g., roll stands) in stations for establishing storage formations (e.g., winding stations) or in stations for dissolving storage formations (e.g., unwinding stations), retrieving loaded or empty supporting elements from the stations, depositing loaded and empty storage elements in storage spaces, retrieving loaded and empty supporting elements from storage spaces and

transporting empty and loaded supporting elements from storage spaces to stations, from stations to storage spaces and if so required from one storage space to another one.

The large number of the steps necessary to be carried out for a predefined management process in a predetermined time sequence is co-ordinated by a superordinate intelligence and is carried out with a higher or lower degree of automation.

In the field of printing, in many instances rolls are used as storage formations. These rolls consist of a roll core and an imbricated formation of a large number of products being wound around the core with the help of a winding tape. The rolls are handled as such (the supporting element being the roll core only) or positioned on roll stands on which the roll core is rotatably mounted. The rolls have usually a diameter of up to two metres and a weight reaching one ton. The axial width of the rolls substantially corresponds to the width of the rolled-up products and amounts for example to 30 to 50 cm. Roll stands suitable for such rolls (also designated as roll cartridges) and methods for handling roll stands are described, for example, in the publications DE-3236866 (or US-4587790), EP-149058 (or US-4676496), EP-242607 (or US-4703901), EP-333648 (or US-5161933) or EP-243837 (or US-4768768).

The roll stands are as simple as possible, mobile (if so required passively displaceable) stable standing devices, on which a roll core is mounted rotatable around a horizontal axis and which in many cases also comprise a device for winding and unwinding the winding tape. An empty roll stand comprises an empty roll core without any printed products rolled onto it; in a loaded roll stand, the roll core carries an imbricated formation of printed products or of other flat articles wound onto it. Roll stands are positioned at correspondingly equipped winding stations and are usually matched to the winding stations in such a manner, that in an unwinding station, an

imbricated formation wound onto the roll stand is directly unravelled, or in a winding station, the imbricated formation is directly wound onto the roll core of a roll stand.

In the printing field, it is not only usual to intermediately store printed products in rolls carried by roll stands, but it is also usual to intermediately store the printed products, for example, in rolls lying on pallets, spirally rolled to form towers being supported by suitable supporting elements or else in rods, wherein all these arrangements of printed products represent storage formations and are carried and/or held together by suitable supporting elements.

It is the object of the invention to create a method and a device for managing an installation for intermediate storage of storage formations of flat articles, in particular of printed products, wherein the installation comprises at least one station for establishing storage formations, at least one station for dissolving storage formations, a plurality of mobile supporting elements and a store with a plurality of storage spaces for storage formations or for supporting elements respectively and wherein the management of the installation comprises the steps of positioning supporting elements with or without storage formations in stations for establishing or for dissolving storage formations and retrieving them from such stations, depositing supporting elements with or without storage formations in storage spaces and removing them from storage spaces, and transporting supporting elements with or without storage formations between stations and storage spaces or between storage spaces. Management according to the invention is to be as simple and as efficient as possible and it shall impose as few as possible spatial conditions on positions for storage spaces and stations and therefore, demand as little space as possible. The device for implementing the management method is to be capable of being operated easily and efficiently in the most diverse spatial conditions. It shall require as little space as possible and it shall be easily expandable.

This objective is achieved by the method and by the device as defined in the independent claims.

The method according to the invention is based on the central idea of splitting-up the as such complex management function into partial functions and of providing various simple partial devices for the purpose of carrying out these partial functions, the partial devices being highly independent of one another. Due to the fact, that they are only responsible for partial functions, these partial devices are simple and all the same highly efficient.

The interaction necessary between partial devices becomes simple and efficient as a result of the fact, that supporting elements with or without storage formations are not transferred from one partial device to another. This is achieved, in that primary partial devices handle supporting elements with or without storage formations, in that secondary partial devices handle primary partial devices loaded with supporting elements carrying storage formations or being empty or empty primary partial devices, in that tertiary partial devices handle secondary partial devices loaded with loaded or empty primary devices or empty secondary partial devices, etc.. This means that when retrieving a supporting element (empty or loaded) from a storage space or from a station for establishing or for dissolving a storage formation, a coupled pair of a supporting element and a primary partial device is formed and the pair is separated only on depositing the supporting element in a storage space or at a station for establishing or dissolving a storage formation. Between retrieving and positioning a specific supporting element, the pair is handled as a unit in any secondary or tertiary steps.

Positioning and retrieving of supporting elements (e.g., roll stands) in stations for establishing or dissolving storage formations (e.g., winding stations) as well as posi-

tioning and retrieving supporting elements in storage spaces are tasks of the primary partial devices, which advantageously retrieve the supporting elements by pulling them or carrying them behind themselves and deposit them by pushing them or by carrying them in front of themselves. The transportation steps to be carried out between the steps of retrieving and positioning may comprise any number, e.g. three partial steps carried out by a primary, a secondary and a tertiary partial device, wherein, however, the pair of supporting element (loaded or empty) and primary partial device is not separated, before the supporting element has reached its destination, i.e., is positioned at the station or in the storage space.

The device in accordance with the invention comprises at least two types of partial devices: a positioning device (primary partial device), with the help of which loaded and empty supporting elements (e.g., roll stands) are positioned at stations for establishing or dissolving storage formations (e.g., winding stations) and in storage spaces and with which loaded or empty supporting elements are retrieved from stations or from storage spaces, and an orienting device (secondary partial device) for orienting the positioning device in the way necessary for positioning or retrieving. In addition, the positioning device carries out primary transport steps to be carried out immediately before or after positioning/retrieval and the orienting device carries out secondary transport steps to be carried out between primary transport steps. For further (tertiary) transport steps and if so required for further orientation steps to be carried out between secondary transport steps, further (tertiary) partial devices may be provided.

The hierarchy of partial steps and of partial devices in accordance with the invention allow management of a store extending in all directions and of an equally free arrangement of stations for establishing or dissolving storage formations without the necessity of transferring supporting elements with or without storage formations from one partial device to another partial device and without transport devices hav-

ing to be equipped for complicated shunting manoeuvres. Resulting from this fact is a great simplicity of the partial devices and a very high efficiency of the method. Advantageously there is a plurality of each type of partial device (primary, secondary, tertiary, etc.) provided in such a manner, that management steps of the same hierarchic level can be carried out simultaneously. As pairs comprising a supporting elements and a primary partial device or comprising a primary and a secondary partial device are formed temporarily, the method according to the invention also has a very high flexibility.

The positioning devices advantageously are equipped in such a manner, that they are able to pull and push passively displaceable supporting elements (e.g., roll stands equipped with rollers) or that they are capable of lifting supporting elements not being equipped for autonomous movement (e.g., roll stands without rollers or pallets) and of carrying them in front of or behind themselves (lifting truck). The positioning devices travel actively in the store along (primary) transport paths, which, for example, are defined by corresponding guide means (e.g., rails or electrically defined guide lines) and run parallel to one another. Along the primary transport paths storage spaces for supporting elements with or without storage formations are provided. The storage spaces advantageously do not comprise any stationary store aids, so that they do not have to be permanently reserved for supporting elements, but can rather be used with a very high degree of flexibility.

The orienting devices are equipped for bringing positioning devices from one of the parallel, primary transport paths to another one and for orienting a positioning device for its subsequent primary transport step. The (secondary) transport path along which the orienting device is actively displaceable is e.g. defined by rails and arranged transverse to the direction of the primary transport paths.

Further, tertiary partial devices can be provided e.g. for transporting orienting devices onto a second or third level (tertiary transport paths).

The method according to the invention and some exemplary embodiments of the device for implementing the method are described in detail on the basis of the following Figures. The Figures and the corresponding descriptions relate to the application of the method and device in accordance with the invention in an installation for intermediate storage of printed products or of other flat articles in rolls, which rolls are established and unravelled in winding stations and which rolls are carried by roll stands. The selection of this application in no way at all constitutes a limitation of the invention to this application. Method and device according to the invention may in the same manner be used for other storage formations usual in the printing field and for corresponding supporting elements, examples of which are mentioned further above.

Figures 1 to 8 show an exemplary sequence of management steps carried out in an installation for intermediate storage of rolls of flat articles according to the inventive method using a positioning device and a one-space orienting device;

Figure 9 shows the use of a two-space orienting device for exchanging roll stands at a winding station;

Figure 10 shows an example of an installation serving for intermediate storage of rolls of flat articles, e.g., printed products, and being managed according to the inventive method;

Figure 11 shows as an example of a supporting element with a storage formation, an exemplary embodiment of a roll stand applicable in the method according to the invention;

Figure 12 shows an exemplary embodiment of a positioning device applicable in the method according to the invention;

Figures 13 and 14 show two exemplary embodiments of an orienting device applicable in the method according to the invention.

Figures 1 to 8 illustrate an exemplary step sequence of the method according to the invention used for retrieving a loaded or empty roll stand (as an example of a supporting element) from a storage space, for bringing it to a winding station (as an example of a station for establishing or dissolving storage formations) and for positioning it in the winding station. All these Figs. show in a plan view part of an installation for intermediate storage of flat articles wound into rolls (as an example of a storage formation) for intermediate storage.

The shown part of the installation encompasses four very schematically illustrated winding stations 1 (1.1 to 1.4), in which a roll stand 2 is inserted through an entrance and from which a roll stand is retrieved by being pulled out in the opposite direction. The shown part of the installation further encompasses a plurality of storage spaces for roll stands 2, the spaces being partially occupied by a roll stand (depicted with an unbroken line and designated with 2.1) and partially empty (depicted with a dot-dash line and designated with 2.2). The storage spaces 2.1 and 2.2 are arranged in rows on a plurality of primary transport paths 3 in such a manner, that the roll axes A are oriented perpendicular to these primary transport paths 3. The entrances of the winding stations are aligned with primary transport paths 3. All primary transport paths 3 intersect a secondary transport path 4.

Figs. 1 to 8 further illustrate a positioning device 5 being actively displaceable in two directions along primary transport paths 3, and an orienting device 6 being actively displaceable in two directions along the secondary transport path 4. At least a part of the orienting device is rotatable around a vertical axis B. The orienting device 6 is single-space, i.e. equipped for handling one positioning device 5 at a time. The illustrated installation is managed according to the invention using the two partial devices 5 and 6.

For not overburdening the Figs. only Fig. 1 contains all reference numerals, while Figs. 2 to 8 only show the relevant ones. Each one of Figs. 1 to 8 shows the situation following a management step and indicated with arrows, the following management step.

The individual steps of the step sequence as illustrated by Figs. 1 to 8 are the following ones:

- taking hold of a roll stand 2 in a storage space 2.1 with the positioning device 5, i.e., establish a pair comprising a roll stand and a positioning device (Fig. 1);

- driving the loaded positioning device 5/2 along the primary transport path 3, if so required through further, empty storage spaces 2.2, to the orienting device 6 being correspondingly positioned on the secondary transport path 4 and positioning it in the area of the orienting device 6 or on the orienting device 6 (Fig. 2);

- taking hold of the loaded positioning device 5/2 with the orienting device 6, for example, by running underneath it and lifting it (Fig. 3);

- transporting the loaded orienting device 6/5/2 to the area of the winding station 1.1 along the secondary transport path 4 and simultaneously re-orienting it by rotating it around axis B (Figs. 4 and 5);

- releasing the loaded positioning device 5/2 from the orienting device 6, for example, by putting it down and removing the underrun (Fig. 6);

- driving the loaded positioning device 5/2 along the primary transport path 3 to the entrance of the winding station 1.1 and positioning the roll stand 2 in the winding station, i.e., separate the pair of roll stand and positioning device (Fig. 7);

- driving the empty positioning device 5 along the primary transport path 3 back to the area of the orienting device 6 (Fig. 8).

In an analogous manner, loaded and empty roll stands are retrieved from winding stations, are transported to any storage space and are deposited there. Also in an analogous manner, if so required roll stands are re-located from one storage space to another one. Also in these cases, the pair consisting of roll stand and positioning device is formed on retrieving and remains unchanged up to positioning.

For exchanging a roll stand in a winding station, the following steps are carried out in the manner illustrated in Figs. 1 to 8: bringing an empty positioning device to the winding station; taking hold of a first roll stand in the winding station; bringing the loaded positioning device to a first storage space; depositing the first roll stand; bringing the empty positioning device to a second storage space; taking hold of a second roll stand deposited there; bringing the loaded positioning device to the winding station; positioning the second roll stand; driving the empty positioning device away.

Before and after every step of positioning or retrieving a roll stand at or from a storage space or at a winding station by a positioning device, a primary transport step is necessary. Depending on the position of the winding station and of the two storage spaces, re-orientation and/or a secondary transport step is necessary between two primary transport steps. Re-orientation and secondary transport are carried out by the orienting device, if so required simultaneously. Two immediately successive, primary transport steps, i.e., crossing the secondary transport path without re-orientation is not possible in the installation in accordance with Figs. 1 to 8.

The installation, of which Figs. 1 to 8 show only a part has primary transport paths 3 and a secondary transport path 4 aligned perpendicular to one another and being straight, the primary transport paths 3, on which the storage spaces 2.1 and 2.2 are located, running parallel to one another. This is an advantageous embodiment, it does not, however, represent a condition for the method in accordance with the invention. Both the primary transport paths 3 as well as the secondary transport path 4 may comprise curves and/or they can intersect at an oblique angle, also in an irregular manner.

Figs. 1 to 8 show clearly that with the method according to the invention it is quite well possible to provide storage spaces 2.1 and 2.2 for roll stands 2 in several depths (with differing distances from the secondary transport path 4) and on both sides of the secondary transport path 4. The positioning device 5 is only capable of accessing roll stands or storage spaces, which can be reached directly from the secondary transport path 4, i.e., which are not separated from it by an occupied storage space.

Figs. 1 to 8 also show, that the distance between adjacent, primary transport paths 3 have to be wide enough for the positioning device 5 to be able to pass roll stands 2 on adjacent primary transport paths and if more than one positioning device is used,

they have to be wide enough for two positioning devices to cross one another on adjacent, primary transport paths 3.

For the method illustrated by Figs. 1 to 8, it is supposed that at least their horizontal projection, supporting elements (e.g., roll stands) carrying a storage formation (e.g., a roll), and empty supporting elements require substantially the same space and that all supporting elements present are essentially the same. This does not represent a condition for the method in accordance with the invention. Because the storage spaces do not require any stationary storage aids, they can be changed in any way required during implementation of the method and they can be utilised for articles of different sizes.

Figure 9 shows in the same, schematic mode as Figs. 1 to 8 a further embodiment of an orienting device 6'. This one has two spaces, i.e. it comprises two spaces for a positioning device 5.1 and 5.2 each and the rotation axis B passes between the two spaces. The positioning devices 5.1 and 5.2 are arranged parallel to one another in the orienting device 6' and have opposite orientations.

The two-space orienting device 6' allows a roll stand exchange at a winding station 1 in a significantly more simple manner, than is the case with the one-space orienting device 6 in accordance with Figs. 1 to 8, if for this exchange it carries an empty positioning device 5.1 and a loaded positioning device 5.2. A roll stand exchange with a two-space orienting device 6' loaded in this manner, has the following step sequence: positioning the orienting device 6' on the primary transport path 3 in such a manner, that the first, empty positioning device 5.1 is oriented for the primary transport step towards the winding station 1; driving the first positioning device 5.1 to the winding station 1 and retrieving the roll stand; driving the first, now loaded positioning device 5.1 back; rotating the orientation device by 180°, so that the second, loaded posi-

tioning device 5.2 is oriented for the primary transport step towards the winding station 1; driving the second positioning device 5.2 to the winding station and positioning the roll stand; driving the second, now empty positioning device back.

Figure 10 shows in the same, very schematic mode as Figs 1 to 9 an exemplary installation, which is managed in accordance with the invention by positioning devices 5 and orienting devices 6 (if so required also two-space orienting devices 6‘). The installation comprises a chessboard-like arrangement of storage spaces 2.1/2.2 for roll stands 2, a row of winding stations 1, a plurality of primary transport paths 3 aligned parallel to an x-axis and two secondary transport paths 4.1 and 4.2 aligned parallel to a y-axis. The storage spaces 2.1/2.2 are situated on the primary transport paths 3 and the entrances of the winding stations 1 are aligned with the primary transport paths 3.

The installation further comprises tertiary partial devices 10 situated at the ends of the secondary transport paths 4. Every tertiary partial device 10 is a sort of elevator and is equipped for transporting a loaded or unloaded orienting device 6 along a tertiary transport path in the direction of the z-axis onto a further level above or below the level depicted in Fig. 9 and for positioning it on a further secondary transport path there. In this, it is not a condition, that on this further level, the secondary and primary transport paths are aligned parallel to those on the depicted level, provided that the tertiary partial device is equipped for re-orienting the orienting device 6. The tertiary partial device 10 (elevator) is actively displaceable along the tertiary transport path and this both empty or loaded with an orienting device 6, which orienting device 6 is empty or is loaded with one (or two) empty or loaded positioning device (or devices 5).

Obviously and in contrast to the installation part as shown in Figs. 1 to 8, in the installation according to Fig. 9 it is possible to take hold of a roll stand for transporting it from the store to a winding station and to deposit it without using the orienting device 6. This is the case if the storage area is the only one occupied or to be occupied on the one primary transport path 3 being aligned with the one winding station 1. The positioning device 5 loaded with the roll stand crosses the secondary transport path 4.1 extending between the store and the winding stations 1 without the need of an orienting device 6.

Advantageously but in no way of necessity, in the installation as illustrated in Fig. 10, the secondary transport path 4.1 extending at the bottom of the Fig. past the winding stations 1 is utilised above all for serving the winding stations 1, while the secondary transport path 4.2 extending on top of the Fig. and passing no winding stations is reserved for rearranging winding stands within the store. If, as is depicted in Fig. 10, storage spaces are only provided on one side of the upper, secondary transport path 4.2, it is not necessary to equip orienting devices 6 running on this transport path with a rotation function.

Obviously, an installation as depicted in Fig. 10 is capable of being expanded in a very simple way. Further storage spaces can e.g. be provided in several depths on the still unoccupied side of the secondary transport path 4.2 extending on top of the Fig. Furthermore, both secondary transport paths 4.1 and 4.2 can be extended either in a straight line or curved and transverse to it further primary transport paths 3 with storage spaces and/or winding stations can be provided.

Figure 11 shows in a side view an exemplary embodiment of a roll stand 2 applicable in the inventive method as a supporting element for a storage formation. The depicted roll stand 2 carries a roll 12 wound onto a roll core 12 (storage formation),

which roll e.g. consists of an imbricated formation of printed products. The roll stand 2 comprises a simple, not passively displaceable support 13, under which a correspondingly equipped positioning device (e.g., a forklift truck) can be run. The roll core 11 is arranged on the support 13, as articulated and rotatable.

As mentioned further above, roll stands of the type illustrated in Fig. 11 are known and can be adapted for the method according to the invention in a simple manner by one skilled in the art.

Figure 12 illustrates an exemplary embodiment of a positioning device 5 applicable as primary partial device in the method according to the invention. The positioning device is depicted loaded with a full roll stand 2. It is an elevating truck 20 with a forklift 21 having supporting rollers at its distal end. A primary transport path 3 suitable for the positioning device 5 and e.g. defined by rails for the positioning device extends in Fig. 11 as indicated by the double arrow.

Elevating trucks, as illustrated in Fig. 11, are available in the market and if so required can easily be adapted by one skilled in the art for the method according to the invention.

A further device applicable as a positioning device in the method according to the invention is described, for example, in the publication EP-333648 (or US-5161933) already mentioned further above.

Figure 13 illustrates an exemplary embodiment of an orienting device 6 applicable as secondary partial device in the method in accordance with the invention. The orienting device is depicted loaded with a loaded positioning device 5. A secondary

transport path suitable for active displacement of the depicted orienting device (secondary transport steps) extends perpendicular to the paper plane of Fig. 12.

The orienting device 6 comprises a supporting beam being displaceable on a pair of rails 31. Arranged as actively rotatable on the supporting beam 30 is a supporting frame 32 adapted to a positioning device 5 as e.g. depicted in Fig. 12. In the lower part of the supporting frame 32, for example, a running substratum 33 (e.g., corresponding stretches of rail) is provided, onto which the positioning device 5 drives actively over a pivoting run-up ramp 34. As indicated for the orienting device in Figs. 1 to 8, it is possible also to provide instead of the running substratum 33 swivelling parts being swivelled under the positioning device 5 for lifting the latter.

The rotation function of the supporting frame 32 is advantageously implemented in such a manner, that the vertical rotation axis B passes approximately through the centre of gravity of a loaded positioning device 5 positioned in the orienting device 6.

For taking hold of and re-orienting an empty or loaded positioning device 5 with the help of the orienting device 6 represented in Fig. 13, the run-up ramp 34 is swivelled down, so that the running substratum 33 connects with a primary transport path, the positioning device 5 is driven onto running substratum 33 over the run-up ramp 34, the run-up ramp is swivelled up and the supporting frame 32 is then rotated. Advantageously, the orienting device 6 is equipped in such a manner, that the supporting frame 32 can be rotated while being displaced along the secondary transport path or along the rails 31 respectively.

Figure 14 illustrates a further, exemplary embodiment of an orienting device 6 applicable in the method according to the invention. The orienting device 6 is depicted unloaded. The same as the embodiment of Fig. 13, it comprises a supporting beam 30 and a supporting frame 32 with running substratum 33 rotatably mounted on it and it is actively displaceable along a pair of rails 31. In the sense of an additional function, the supporting frame 32 is elevatable to at least one further level 41 (or also lowerable) e.g. by synchronously drivable chain hoists 40, which act on the supporting beam 30. On the further levels, a loaded positioning device can be released onto further primary transport paths. An analogous elevating mechanism may be used also for slightly raising a positioning device held on the orienting device 6 e.g. by swivelling parts swivelled underneath it, in order to re-orient it and/or transport it along the secondary transport path.

Fig. 14 depicts the supporting frame on the base level with an unbroken line and with a dot-dash line on the further, upper level 41.

The swivelling run-up ramp 34 arranged on one side of the running substratum 33 serves the additional function (elevation or lowering to further levels) also. It is in the swivelled up position during raising or lowering to a further level and it is swivelled down, as soon as the supporting frame 32 is in a position, in which a positioning device can drive up onto it or away from it.

For re-orientation associated with a level change of a positioning device loaded onto the orienting device 6 in accordance with Fig. 14, the following partial steps are necessary: driving the positioning device, e.g., on the base level onto the running substratum 33 of the correspondingly positioned supporting frame 32; swivelling up the run-up ramp 34; raising the supporting frame 32 to a further level 41 and advantageously simultaneously rotating it and if so required displacing it along a secondary

transport path; swivelling down the run-up ramp 34; driving the positioning device off.

With the orienting device 6 in accordance with Fig. 14, it is possible to arrange storage areas and if so required also winding stations on more than one level, without the installation requiring tertiary partial devices 10 (as indicted in Fig. 9), and all levels can be jointly managed with the same positioning devices. Because transport along the secondary transport path, displacement from one level to another one and reorientation can be carried out simultaneously, the method according to the invention with the aid of this embodiment of orienting device becomes particularly efficient.

Knowing the function of the orienting device, one skilled in the art can easily implement embodiments of orienting devices in accordance with Figs. 13 and 14 or other embodiments derived from these, the devices having one or two spaces for positioning devices. Therefore, the devices do not need to be described in further detail.